We claim:

1. A method of operating a reactor core, comprising:

operating a reactor core according to an initial operating plan developed in expectation of an in-cycle shut down;

shutting down the reactor core during a cycle; and

moving one or more fuel bundles of the reactor core to new positions within the reactor core to increase a total energy output of the reactor core as compared to continuing operation of the reactor core without the shutting down and moving steps.

2. The method of claim 1, further comprising:

selecting an optimal in-cycle shutdown time; and wherein

the shutting down step is performed at the selected in-cycle shutdown time.

3. The method of claim 1, further comprising:

developing a shuffling strategy; and wherein

the moving step is performed based on the developed shuffling strategy.

4. The method of claim 1, further comprising:

selecting an in-cycle shut down time and developing a shuffling strategy to maximize energy generated by the reactor core; and wherein

the shutting down step is performed at the selected in-cycle shutdown time; and

the moving step is performed based on the developed shuffling strategy.

5. The method of claim 1, wherein

the shutting down step is performed at substantially mid-cycle.

6. The method of claim 1, further comprising:

removing one or more defective fuel bundles.

7. The method of claim 1, further comprising:

replacing one or more defective fuel bundles.

8. The method of claim 7, wherein the replacing step replaces at least one defective fuel bundle with a fresh fuel bundle.

9. The method of claim 7, wherein the replacing step replaces at least one defective fuel bundle with an exposed fuel bundle from a fuel pool.

10. The method of claim 1, further comprising:

replacing one or more fuel bundles.

11. The method of claim 10, wherein the replacing step replaces at least one fuel bundle with a fresh fuel bundle.

12. The method of claim 10, wherein the replacing step replaces at least one fuel bundle with an exposed fuel bundle from a fuel pool.

13. The method of claim 1, further comprising:

developing the initial operating plan in expectation of an in-cycle shutdown.

14. The method of claim 13, wherein the developing step comprises:

first simulating nuclear reactor operation for sets of independent control variable values to produce associated sets of dependent performance variable values;

generating polynomials based on the sets of independent control variable values and the sets of dependent performance variable values, the

polynomials representing relationships between the independent control variables and the dependent performance variables;

generating additional sets of dependent performance variable values for additional sets of independent control variable values using the generated polynomials; and

determining a set of independent control variable values for possible use in operating a nuclear reactor based on the sets of dependent performance variable values and the additional sets of dependent performance variable values.

15. A method of operating a reactor core, comprising:

operating a reactor core according to an initial operating plan developed in expectation of an in-cycle shut down;

shutting down a reactor core during a cycle; and

moving one or more fuel bundles of the reactor core to new positions within the reactor core to increase a total revenue generated from the energy produced by the reactor core as compared to continuing operation of the reactor core without the shutting down and moving steps.

16. The method of claim 15, further comprising:

selecting an optimal in-cycle shutdown time; and wherein

the shutting down step is performed at the selected in-cycle shutdown time.

17. The method of claim 15, further comprising:

developing a shuffling strategy; and wherein

the moving step is performed based on the developed shuffling strategy.

18. The method of claim 15, further comprising:

selecting an in-cycle shut down time and developing a shuffling strategy to maximize the total revenue generated by the reactor core; and wherein

the shutting down step is performed at the selected in-cycle shutdown time; and

the moving step is performed based on the developed shuffling strategy.